Residual stress in polymer composites: Characterisation using Contour Method

Other

RESIDUAL STRESS IN POLYMER COMPOSITES

Characterisation using Contour Method

Residual Stress: Locked-in stress in materials as a result of manufacturing process

Contour Method: A powerful 2D residual stress mapping technique

Polymer Composite: Plastic resin with reinforcing (carbon & glass) fibres

Space, aircraft, defence & automobile industries are extensively utilizing polymer composites more than metals & alloys to achieve high performance structures.

Why polymer composites?

Polymer composites offer high strength-to-weight ratio & resistance to corrosion & fatigue compared to conventional metals & alloys.

Why this research?

Despite the many applications of polymer composites, a key aspect that still needs addressing is reliable characterisation of residual stress induced in the composites during manufacturing process.

Lack of “best practice guide” regarding what method to use for measuring bulk (through-thickness) residual stress.

Samples: Research is focussed on pipes & pressure vessel components provided by industrial sponsor CETIM - France

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Failure of NASA X-33

- X-33 was a reusable launch vehicle, cancelled due to failure of liquid hydrogen cryogenic tank due to cracks generated by **residual stress.**
- Project cost: **$922 million** NASA
  + **$357 million** Lockheed Martin.

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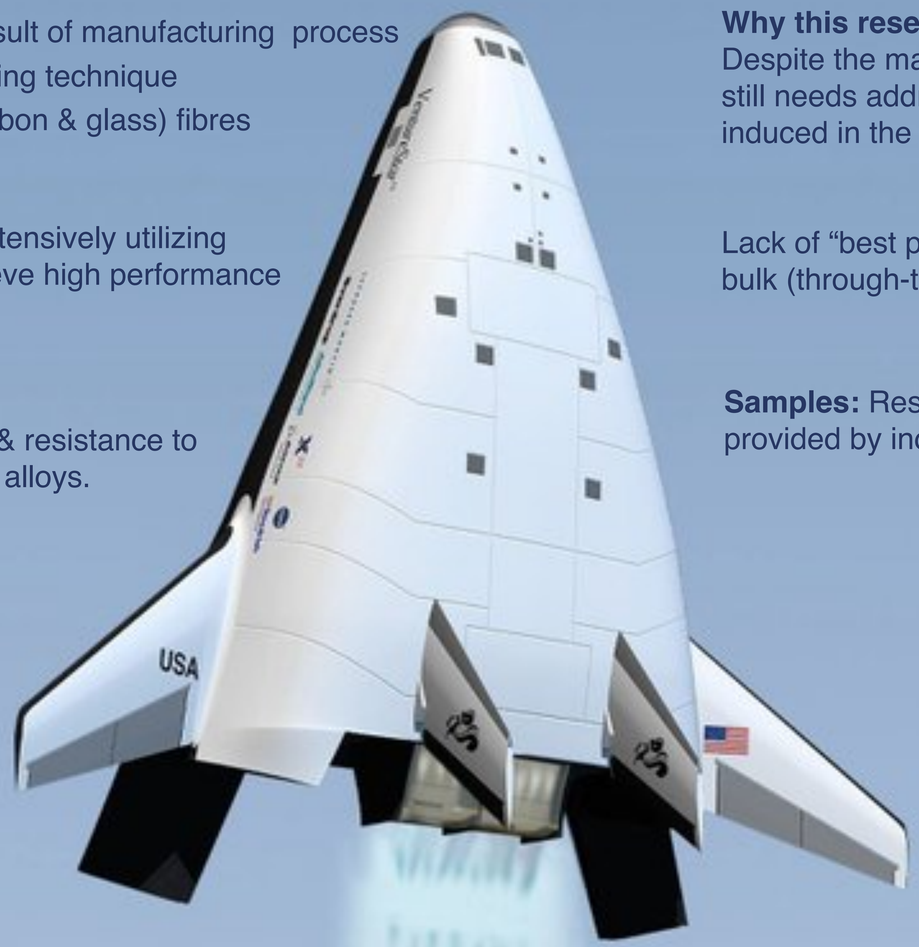
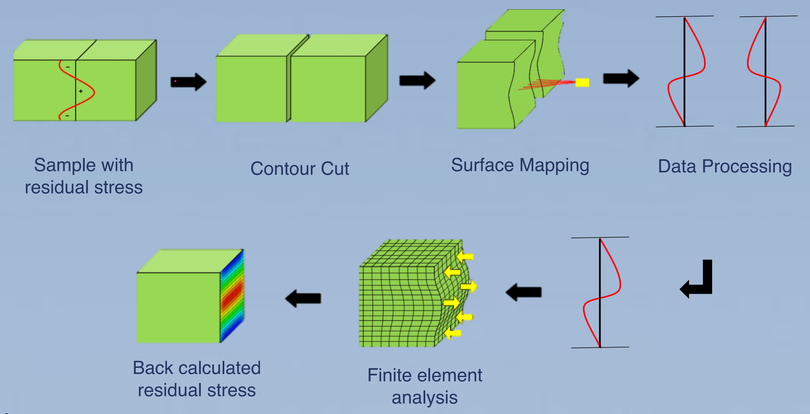


NASA X-33 Space Vehicle

Detrimental effect of residual stress in composite liquid hydrogen tank

Contour Method



Research Question: Can the contour method be applied to measure the residual stress in polymer composites?
What are the potential cutting techniques for non-conductive composite materials?
What are the surface measurement methods and how to process?
How to model the anisotropic and heterogeneous behaviour of polymer composites for back-calculating the residual stress?
How to validate the contour method results?

End application: Optimizing the manufacturing route of polymer composites
Improved life prediction of safety-critical structures with lower uncertainties

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